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*G*ENESIS RESEARCH SAMPLE INVESTIGATOR'S GUIDEBOOK

Astromaterials Acquisition and Curation Office/KT
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1. PURPOSE OF THIS GUIDEBOOK

The Genesis Research Sample Investigator's Guidebook is a reference source for Genesis sample investigators and prospective investigators with descriptions of specific procedures for requesting research samples and requirements for care of any samples allocated. Much of this guidebook addresses documentation. Where practical, electronic documentation or facsimiles are acceptable, and in many cases preferred for increased efficiency. However, signed papers are required for Loan Agreements and annual Sample Investigator inventories, and these files are maintained by the Genesis Curator.

2. OVERVIEW OF THE GENESIS SOLAR WIND SAMPLE COLLECTION

NASA's Genesis mission (August 2001 – September 2004) carried 301 polished collection surfaces comprised of materials listed in Table 1. These were arranged on arrays exposed to specific solar wind regimes. Due to the unplanned hard landing, the polished collectors were dislodged from their array frames and broken into more than 10,000 fragments. The fragment thicknesses are characteristic of the solar wind regime collected: bulk solar wind in 700 μm , transient solar wind associated with coronal mass ejections in 650 μm , high-speed solar wind from coronal holes in 600 μm , and low-speed interstream solar wind in 550 μm thick collectors.

Table 1 Array Collector Materials List

Material	Description
FZ Si	<100> single crystal silicon made by the Float Zone method
CZ Si	<100> single crystal silicon made by the Czochralski (crystal pulling) method
SOS	Epitaxially-grown single crystal silicon on single crystal sapphire
AlOS	Vapor deposited aluminum (about 250 nm thick) on single crystal sapphire
AuOS	Vapor deposited gold (about 250 nm thick) on single crystal sapphire
Sapphire	Single crystal sapphire
Diamond	Amorphous diamond like carbon (about 3 microns thick) on silicon
Ge	Single crystal germanium (only mm-sized fragments survived)

The fragments have been contaminated with both particulates and molecular films. Limited cleaning of fragments is offered, and this capability is still under development. Characterization of the fragment condition with regard to fragment thickness, surface damage, particle distribution and film thickness is provided. Systematic characterization of the entire collection has been initiated, but is expected to take several years. Presently, most allocations are characterized upon demand (a catalog of allocation candidate fragments is not yet available). Contact the Genesis Solar Wind Sample Curator for updated characterization and cleaning information.

In addition to the array collectors, several experiment-specific collectors were recovered. The "early science" materials, the gold foil and the polished aluminum sheet, were recovered intact, but damaged. The investigator-dedicated molybdenum-covered platinum foils were badly wrinkled. The bulk metallic glass was intact, but suffered surface impact damage. Three of the four ion concentrator targets were intact, and 80% of the fourth was recovered.

A comprehensive description of the pre-flight condition of the collectors can be found in Jurewicz A. J. G. *et al.* (2002) *Space Science Reviews*, **105**, 535-560. Progress on the characterization and cleaning development are posted on the internet at <http://curator.jsc.nasa.gov/>.

3. ACCESS TO GENESIS SOLAR WIND SAMPLES

NASA policies define Genesis solar wind samples as a limited national and future heritage resource. These policies require that samples be released only for approved applications in research, education, and public display. To meet that responsibility, NASA carefully screens all sample requests. The review process is delegated to the Genesis Allocation Subcommittee of the Curation Analysis and Planning Team for Extraterrestrial Materials (CAPTEM) and the Genesis Solar Wind Sample Curator. Subcommittee allocation approval and concurrence by the Director of the Solar System Division at NASA Headquarters allows the Genesis curator to prepare and send samples. This document does not address samples for educational activities and public display.

4. SUBMITTING SAMPLE REQUESTS

Sample requests should be submitted directly to the Genesis Solar Wind Sample Curator at the following address:

Judith H. Allton
Genesis Solar Wind Sample Curator
Mail Code KT
Johnson Space Center
2101 NASA Parkway
Houston , TX 77058

281-483-5766 voice
281-483-5347 fax
judith.h.allton@nasa.gov

Receipt of requests will be confirmed by the curator. Requests determined to be sufficiently mature to warrant consideration for use of Genesis materials will be forwarded to Genesis Allocation Subcommittee of CAPTEM by the Genesis Curator. Electronic submissions will expedite the allocation review process. The basic request should be no more than 10 pages (single spaced). There is no limit on the amount of attached documentation. The Subcommittee will process applications on an ongoing basis, as received. The Allocation Subcommittee may set up a teleconference with the applicant to discuss requests. All individuals requesting a Genesis solar wind sample must follow the appropriate requirements and guidelines in sections 4.1 and 4.2 below.

4.1 COLLECTOR ARRAY RESEARCH SAMPLES

The allocation request must provide documentation on the following topics:

- 4.1.1 A specific statement of science objectives and a description of the analyses to be made. A proposed level of sensitivity, precision and accuracy should be given based on the science objective(s). General precision/accuracy goals, as published in past mission documents, are given in Appendix A. If these goals can be exceeded, there is no issue, but the Committee also recognizes that there may be cases where a lesser degree of precision might be scientifically justified. This is especially true in the initial round of analyses. Such a justification must be included in the submitted request.
- 4.1.2 The overall sensitivity, precision and accuracy of analytical techniques. These should be demonstrated on standards and other materials. A description must be provided of analytical blanks, background effects and how sample handling procedures will minimize contamination and interferences.
- 4.1.3 A plan for surface cleaning. The Project and the Curatorial Facility are committed to providing samples with clean surfaces. However, as cleanliness requirements will vary with the analysis proposed, surface cleanliness requirements and a plan for meeting these must be included with allocation requests. A simple type of cleaning plan would be a method to prove that the Curatorial Facility has cleaned the sample well enough to meet requirements. An alternative is for applicants to propose to receive samples dirty and do their own cleaning. In this case, cleaning tests must be documented to demonstrate that cleanliness requirements can be met.
- 4.1.4 The solar wind regime, collector material type, size and shape required. A catalog with images of available pieces will eventually be produced, but in the meantime, allocation requests should be made in general terms: *e.g.*, X cm² of material Y from solar wind regime Z. Initially, the primary type of allocation will be of existing fragments that meet size and shape requirements. Later, subdivision of larger pieces will be done, by backside laser scribing followed by manual cleaving.
- 4.1.5 A sample shipping plan. Investigator-designed shipping containers are encouraged. The design of these should be worked out in advance with the Curatorial Facility staff and the plans included with the allocation request. Contact the Genesis curator for a list of shipping containers available from the Curatorial Facility.

4.2 CONCENTRATOR TARGET RESEARCH SAMPLES

Concentrator targets were specifically designed to enable analyses for oxygen and nitrogen. The total area comprised by the targets is about 25 cm²; therefore, allocations of material will be very carefully considered. After calibration of the ion focusing is completed, the Subcommittee will accept requests for concentrator samples.

In similar manner for the array collector samples, requests for concentrator target materials will require: a) a statement of science objectives, b) overall sensitivity, precision and accuracy of analytical techniques, c) a plan for surface cleaning (if needed), d) material type (SiC, 13-C Vapor-Deposited diamond, amorphous diamond-like-carbon on silicon), size and shape, and e) a shipping plan. Detailed requirements for concentrator sample requests will be posted on the curatorial website: <http://curator.jsc.nasa.gov/>. Subdivision of concentrator targets by laser cutting is under development. Check with the Genesis sample curator for the status of target calibration and specimen subdivision by laser cutting.

5 LOAN AGREEMENTS AND USER AGREEMENTS

Definitions:

Sample Investigator – the person to whom responsibility for security and accountability for the Genesis solar wind sample is assigned. Usually this is the person who submitted the request for samples. This person signs the **Loan Agreement** and signs the Genesis Sample Assignment form when samples are received.

Sample Collaborator – a person working with the Sample Investigator who may have temporary custody of the sample for analytical purposes. This person signs the **User Agreement**.

After the Genesis Allocation Committee endorsement and concurrence by the Director of Solar System Division at NASA Headquarters, the Genesis Solar Wind Sample Curator will prepare a **Loan Agreement** for the Sample Investigator. The agreement delineates the responsibilities of the new investigator, including security and accountability procedures required to minimize prospects for theft or unauthorized use of Genesis samples (example Loan Agreement is shown in Appendix B). Upon return receipt of the properly executed loan agreement, the Genesis Solar Wind Sample Curator prepares the authorized samples and sends them to the investigator.

The Sample Investigator signing the Loan Agreement is the accountable person responsible for the security and tracking of the specimens assigned to him or her. Because Genesis samples often require collaborative analyses at different locations, the accountable Sample Investigator may send samples to qualified collaborators for short periods. However, the accountable Sample Investigator is still responsible for the samples. The collaborator receiving samples becomes a qualified Sample Collaborator by signing, and having on file with the Genesis Curator prior to receipt of samples, a **User Agreement** (example User Agreement is shown in Appendix B). User Agreements detail the sample handling, storage and transfer protocols required to protect the Genesis solar wind samples from theft or loss. A signed facsimile on file with the curator is adequate until a paper copy arrives. The accountable Sample Investigator shall not send Genesis solar wind samples to anyone not having a signed User Agreement on file with the Genesis Curator.

6 CONTINUATION AS A GENESIS SOLAR WIND SAMPLE INVESTIGATOR

Any Sample Investigator or Sample Collaborator's privilege for retention and use of Genesis solar wind samples is contingent upon fulfilling the following obligations: (1) maintenance of, and adherence to, the Genesis Sample Loan Agreement or User Agreement; (2) timely cooperation with annual Genesis solar wind sample inventory; (3) timely cooperation with sample recalls, and d) continued need for retention of samples for planned, timely experiments.

7 GENESIS SAMPLE ACCOUNTABILITY AND SECURITY

Genesis solar wind samples are the property of the United States Government, and it is NASA's policy that Genesis solar wind sample materials will be used only for authorized purposes. It is therefore essential that rigorous accountability and security procedures be followed by all persons who have access to Genesis solar wind materials.

7.1 GENESIS SAMPLE SECURITY

A Genesis research Sample Investigator is responsible for the control and safeguarding of all Genesis solar wind samples consigned to his/her custody. Keeping Genesis samples under supervision or control of the Investigator and/or their designee is required. When not in use, the samples must be locked in a safe or secure storage cabinet equipped with a combination padlock, or, if controlled environment is required, in a locked laboratory. Combination to the storage safe or cabinet will be under the exclusive control of the Investigator and/or his/her designee. During use the samples must remain under the control of the Investigator. At the end of each use an inventory shall be made to insure the accountability of the samples. Such inventories shall be maintained as a permanent record and shall be made accessible to NASA at all reasonable times. Requirements for supervision of samples during transit are given in section 8 below. In no case may the Genesis solar wind samples be stored with money, precious stones or minerals, classified material, or any other item that is considered to be of high theft potential. In the event a sample is missing, lost, or cannot be accounted for, the Investigator must immediately report it to the Genesis Sample Curator.

7.2 GENESIS SOLAR WIND SAMPLE ACCOUNTABILITY

Genesis solar wind Sample Investigators are expected to maintain complete records of the use of Genesis solar wind samples in their possession. The samples become the Sample Investigator's responsibility when he or she accepts delivery of the samples from NASA, and that responsibility ends only when (1) the samples have been returned to NASA in the manner authorized, and (2) all sample material has been accounted for. The following sections specify requirements of sample accountability which must be met by a Genesis solar wind sample investigator.

7.2.1 Use of Electronic Documents

Electronic documents may be used to increase efficiency under these conditions: a) verification of sample transfers by electronic media shall be from Investigators using institutional computer accounts secured with password protection under the exclusive control of the Investigator, b) facsimile copies must be signed and be comparable to a signature on record with the Curator (for example, the Loan Agreement). The Curator

will print paper copies of transfer documents and other documents for inclusion in the Curator's permanent record for Sample Investigators. Paper documents are required for the Loan Agreement and the annual inventory.

7.2.2 Documentation of Sample Transfers Between Curator and Investigator

All sample transfers between the Genesis Curator and Sample Investigators must be documented. By signing the transfer document, the recipient Sample Investigator becomes accountable for the sample. An Investigator may delegate authority to another person to receive samples in his/her name. Such a delegation of authority must be in writing and a copy must be on file with the Genesis Curator (e-mail to the Genesis Curator is acceptable and will be printed for file copy). A delegation of authority does not relieve the Sample Investigator of responsibility for samples received by his or her delegated alternate.

7.2.2.1 Samples transmitted by the Genesis Curator are accompanied by a *Genesis Sample Assignment* form, an example of which is shown as Appendix C. Upon receipt of samples, the form must be signed by the Sample Investigator and returned to the Genesis Sample Curator (signed facsimile is acceptable; however, the investigator assumes the responsibility of verifying that the form was received by the Genesis Curator).

7.2.2.2 Transfers of sample accountability are not permitted between or among investigators. Samples must be returned to the Genesis curator for re-issue.

7.2.3 Sample Return Documentation

All Genesis solar wind samples and residues remaining at the completion of experiments or investigations are to be returned to the Genesis Curator. Upon the receipt of the samples and sample accountability and history documentation from a Sample Investigator, the database will be updated and the Genesis Curator will issue a *Genesis Sample Return Receipt* (Appendix D) for research samples.

For each sample returned to the curator, a history of the sample handling by the Investigator shall be provided. This history shall include analytical or cleaning procedures applied to the sample and exposure to any environments or chemicals that alter the sample.

7.2.4 Investigator Responsibility for Internal Sample Transfers

Genesis specimen research often requires analytical capabilities of several institutions applied to an individual sample, requiring rapid transfer between investigators at different locations. The accountable Sample Investigator may send samples to a Sample Collaborator having a valid Loan Agreement or User Agreement on file with the Genesis curator for short periods (less than two months). The Sample Investigator who accepted responsibility for the sample, by signing the Sample Assignment Form, remains responsible for sample security and accountability activities of their Sample Collaborators until the samples are officially returned to the Curator.

8. GENESIS SOLAR WIND SAMPLE INVENTORY

Annually, the Genesis Curator will provide each Sample Investigator with a complete inventory listing of samples in the Investigator's possession for which the Investigator is accountable. The Sample Investigator is expected to review and verify the listing of current sample holdings to ensure that all samples are appropriately listed. The residues from any samples destroyed during analysis shall be returned to the Curator. The annual inventory must be personally supervised by the Sample Investigator and witnessed by a colleague, security official or other official of the investigator's institution. The verified inventory listing is to be promptly returned to the Genesis Curator. Appendix E is an example of an inventory listing.

Where samples are in the possession of a Sample Collaborator at the time of the annual inventory, the Sample Investigator may authorize (in writing, signed facsimile is adequate) the collaborator to conduct the inventory and account for those samples assigned to the Sample Investigator. The properly witnessed verification must be provided to the accountable Sample Investigator, who will transmit it to the Genesis Curator as part of his or her total inventory verification. In no case will the verification of sample inventory by any person other than a Sample Investigator or Sample Collaborator, having a valid User Agreement, be accepted by the Genesis Curator.

9. NUMBERING OF SAMPLES

Permanent numbers for samples are assigned by the Genesis Sample Curator's staff. Sample Investigators are required to identify all subsamples they create by a designated numbering system and account for them in their sample history. This numbering scheme must be explicitly written and available for inspection by NASA when security and inventory spot checks are conducted.

10. SAMPLE SHIPPING

Samples may be transferred by Federal Express or equivalent reliable courier service that provides online, real-time tracking of shipment. The advantage of using online, real-time tracking is that delivery of the sample package can be verified the day of delivery and a search immediately initiated, if needed. The process for shipping has three steps. First, the shipper (usually the Genesis curatorial staff) communicates with the recipient to verify that someone will be there to accept delivery on a certain day. Second, the shipper sends an e-mail announcing that the package has been sent for delivery on a certain date. This message includes the tracking number and a reminder that the recipient should promptly acknowledge receipt of package. Third, if no response is received on delivery date from the recipient, the shipper will send an e-mail query asking for confirmation of delivery. A search shall begin immediately, if needed.

Fed Ex forms require a value of package contents. This value shall be recorded as "zero". To preclude inadvertent opening by mail room employees, place inside the box a prominent message "MAIL ROOM EMPLOYEES: THIS PACKAGE CONTAINS MATERIALS TO BE OPENED ONLY IN A CLEANROOM". Samples should be sealed in at least two layers of packaging so that exterior packaging can be removed prior to cleanroom entry.

Appendix A

Sensitivity and Precision Goals

Precision and Accuracy of Elemental and Isotopic Analyses:

Elemental Accuracy (2σ limits) = $\pm 10\%$ of the number of atoms of each element per cm^2 on the collector materials

Isotopic Precision (2σ limits on the abundance ratios of the different isotopes of an element compared to a terrestrial reference standard)

C and N $\pm 4\%$

O and Ti $\pm 1\%$

Others $\pm 10\%$

A special effort will be made to measure the rare gas isotopes, and the abundant ones will be measured to much better than 10 %. However, it is recognized that 10 % may not be achievable for ^{124}Xe , ^{126}Xe , and ^{78}Kr .

These goals remain the basic point of reference for the Subcommittee, but we recognize that Cosmochemical knowledge has evolved since these goals were written in 1996. For example, it is likely that measurements of the N and O isotopic compositions with lesser precision than given would answer major science questions. Consequently, the Subcommittee is open to allocation requests that define a level of precision consistent with meeting the proposed science objectives.

An acceptable alternative to meeting *elemental* accuracy goals, analogous to those given here, is to improve on present knowledge of spectroscopic photospheric abundances by at least a factor of 3. The Subcommittee adopts the error estimates of photospheric abundances as given by M. Asplund, N. Grevesse, and A. J. Sauval (2005) The solar chemical composition. In *Cosmic Abundances as Records of Stellar Evolution and Nucleosynthesis* (Eds. F. N. Bash and T. G. Barnes), ASP Conference Series, in press (astro-ph 0410214). Their Table 1 is given below.

The solar chemical composition

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Table 1. Element abundances in the present-day solar photosphere and in meteorites (C1 chondrites). Indirect solar estimates are marked with [..]

Elem.	Photosphere	Meteorites	Elem.	Photosphere	Meteorites
1 H	12.00	8.25 ± 0.05	44 Ru	1.84 ± 0.07	1.77 ± 0.08
2 He	[10.93 ± 0.01]	1.29	45 Rh	1.12 ± 0.12	1.07 ± 0.02
3 Li	1.05 ± 0.10	3.25 ± 0.06	46 Pd	1.69 ± 0.04	1.67 ± 0.02
4 Be	1.38 ± 0.09	1.38 ± 0.08	47 Ag	0.94 ± 0.24	1.20 ± 0.06
5 B	2.70 ± 0.20	2.75 ± 0.04	48 Cd	1.77 ± 0.11	1.71 ± 0.03
6 C	8.39 ± 0.05	7.40 ± 0.06	49 In	1.60 ± 0.20	0.80 ± 0.03
7 N	7.78 ± 0.06	6.25 ± 0.07	50 Sn	2.00 ± 0.30	2.08 ± 0.04
8 O	8.66 ± 0.05	8.39 ± 0.02	51 Sb	1.00 ± 0.30	1.03 ± 0.07
9 F	4.56 ± 0.30	4.43 ± 0.06	52 Te		2.19 ± 0.04
10 Ne	[7.84 ± 0.06]	-1.06	53 I		1.51 ± 0.12
11 Na	6.17 ± 0.04	6.27 ± 0.03	54 Xe	[2.27 ± 0.02]	-1.97
12 Mg	7.53 ± 0.09	7.53 ± 0.03	55 Cs		1.07 ± 0.03
13 Al	6.37 ± 0.06	6.43 ± 0.02	56 Ba	2.17 ± 0.07	2.16 ± 0.03
14 Si	7.51 ± 0.04	7.51 ± 0.02	57 La	1.13 ± 0.05	1.15 ± 0.06
15 P	5.36 ± 0.04	5.40 ± 0.04	58 Ce	1.58 ± 0.09	1.58 ± 0.02
16 S	7.14 ± 0.05	7.16 ± 0.04	59 Pr	0.71 ± 0.08	0.75 ± 0.03
17 Cl	5.50 ± 0.30	5.23 ± 0.06	60 Nd	1.45 ± 0.05	1.43 ± 0.03
18 Ar	[6.18 ± 0.08]	-0.45	62 Sm	1.01 ± 0.06	0.92 ± 0.04
19 K	5.08 ± 0.07	5.06 ± 0.05	63 Eu	0.52 ± 0.06	0.49 ± 0.04
20 Ca	6.31 ± 0.04	6.29 ± 0.03	64 Gd	1.12 ± 0.04	1.03 ± 0.02
21 Sc	3.05 ± 0.08	3.04 ± 0.04	65 Tb	0.28 ± 0.30	0.28 ± 0.03
22 Ti	4.90 ± 0.06	4.89 ± 0.03	66 Dy	1.14 ± 0.08	1.10 ± 0.04
23 V	4.00 ± 0.02	3.97 ± 0.03	67 Ho	0.51 ± 0.10	0.46 ± 0.02
24 Cr	5.64 ± 0.10	5.63 ± 0.05	68 Er	0.93 ± 0.06	0.92 ± 0.03
25 Mn	5.39 ± 0.03	5.47 ± 0.03	69 Tm	0.00 ± 0.15	0.08 ± 0.06
26 Fe	7.45 ± 0.05	7.45 ± 0.03	70 Yb	1.08 ± 0.15	0.91 ± 0.03
27 Co	4.92 ± 0.08	4.86 ± 0.03	71 Lu	0.06 ± 0.10	0.06 ± 0.06
28 Ni	6.23 ± 0.04	6.19 ± 0.03	72 Hf	0.88 ± 0.08	0.74 ± 0.04
29 Cu	4.21 ± 0.04	4.23 ± 0.06	73 Ta		-0.17 ± 0.03
30 Zn	4.60 ± 0.03	4.61 ± 0.04	74 W	1.11 ± 0.15	0.62 ± 0.03
31 Ga	2.88 ± 0.10	3.07 ± 0.06	75 Re		0.23 ± 0.04
32 Ge	3.58 ± 0.05	3.59 ± 0.05	76 Os	1.45 ± 0.10	1.34 ± 0.03
33 As		2.29 ± 0.05	77 Ir	1.38 ± 0.05	1.32 ± 0.03
34 Se		3.33 ± 0.04	78 Pt		1.64 ± 0.03
35 Br		2.56 ± 0.09	79 Au	1.01 ± 0.15	0.80 ± 0.06
36 Kr	[3.28 ± 0.08]	-2.27	80 Hg		1.13 ± 0.18
37 Rb	2.60 ± 0.15	2.33 ± 0.06	81 Tl	0.90 ± 0.20	0.78 ± 0.04
38 Sr	2.92 ± 0.05	2.88 ± 0.04	82 Pb	2.00 ± 0.06	2.02 ± 0.04
39 Y	2.21 ± 0.02	2.17 ± 0.04	83 Bi		0.65 ± 0.03
40 Zr	2.59 ± 0.04	2.57 ± 0.02	90 Th		0.06 ± 0.04
41 Nb	1.42 ± 0.06	1.39 ± 0.03	92 U	<-0.47	-0.52 ± 0.04
42 Mo	1.92 ± 0.05	1.96 ± 0.04			

There are two ways to measure *elemental* abundances: Absolute Fluence and Relative. The Absolute Fluence approach is to divide the number of atoms of the element measured by the area analyzed. The Relative approach eliminates the necessity to measure an analyzed area by measuring the amounts of an element to some major element such as Mg, Si, Ca, or Fe. For the Relative approach, the relevant precision goal is the analytical error in the measured element ratio compared to the propagated error in the photospheric abundance ratio. Many analyses should be able to use both approaches.

Appendix A (con't). This table taken from Burnett D. S. *et al.* (2003) *Spa. Sci. Rev.*, 105: 509-534.

Table 2. Estimated Composition of Bulk Solar Wind (Note 1)

Z	Element	Solar system abundance (Note 2)	Solar wind flux (cm ⁻² s ⁻¹)	2-yr. fluence (cm ⁻²)	ppma (Note 3)	ppmw (Note 4)
3	Li	5.7E+01	1.7E+00	1.1E+08	2.2E-04	5.3E-05
4	Be	7.3E-01	2.2E-02	1.4E+06	2.8E-06	8.9E-07
5	B	2.1E+01	6.4E-01	4.0E+07	8.0E-05	3.1E-05
6	C	1.0E+07	1.0E+05	6.3E+12	1.3E+01	5.4E+00
7	N	3.1E+06	3.1E+04	2.0E+12	3.9E+00	2.0E+00
8	O	2.4E+07	2.4E+05	1.5E+13	3.0E+01	1.7E+01
9	F	8.4E+02	8.4E+00	5.3E+08	1.1E-03	7.2E-04
10	Ne	3.4E+06	3.4E+04	2.2E+12	4.3E+00	3.1E+00
11	Na	5.7E+04	1.7E+03	1.1E+11	2.2E-01	1.8E-01
12	Mg	1.1E+06	3.2E+04	2.0E+12	4.1E+00	3.5E+00
13	Al	8.5E+04	2.5E+03	1.6E+11	3.2E-01	3.1E-01
14	Si	1.0E+06	3.0E+04	1.9E+12	3.8E+00	3.8E+00
15	P	1.0E+04	2.1E+02	1.3E+10	2.6E-02	2.9E-02
16	S	5.2E+05	1.0E+04	6.5E+11	1.3E+00	1.5E+00
17	Cl	5.2E+03	5.3E+01	3.3E+09	6.7E-03	8.3E-03
18	Ar	1.0E+05	1.0E+03	6.4E+10	1.3E-01	1.7E-01
19	K	3.8E+03	1.1E+02	7.1E+09	1.4E-02	2.0E-02
20	Ca	6.1E+04	1.8E+03	1.2E+11	2.3E-01	3.3E-01
21	Sc	3.4E+01	1.0E+00	6.5E+07	1.3E-04	2.1E-04
22	Ti	2.4E+03	7.2E+01	4.5E+09	9.1E-03	1.5E-02
23	V	2.9E+02	8.8E+00	5.5E+08	1.1E-03	2.0E-03
24	Cr	1.4E+04	4.0E+02	2.6E+10	5.1E-02	9.4E-02
25	Mn	9.6E+03	2.9E+02	1.8E+10	3.6E-02	7.1E-02
26	Fe	9.0E+05	2.7E+04	1.7E+12	3.4E+00	6.8E+00
27	Co	2.2E+03	6.7E+01	4.3E+09	8.5E-03	1.8E-02
28	Ni	4.9E+04	1.5E+03	9.3E+10	1.9E-01	3.9E-01
29	Cu	5.2E+02	1.6E+01	9.9E+08	2.0E-03	4.5E-03
30	Zn	1.3E+03	3.8E+01	2.4E+09	4.8E-03	1.1E-02
31	Ga	3.8E+01	1.1E+00	7.2E+07	1.4E-04	3.5E-04
32	Ge	1.2E+02	3.6E+00	2.3E+08	4.5E-04	1.2E-03
33	As	6.6E+00	2.0E-01	1.2E+07	2.5E-05	6.6E-05
34	Se	6.2E+01	1.9E+00	1.2E+08	2.4E-04	6.6E-04
35	Br	1.2E+01	1.2E-01	7.3E+06	1.5E-05	4.2E-05
36	Kr	4.5E+01	4.5E-01	2.8E+07	5.7E-05	1.7E-04
37	Rb	7.1E+00	2.1E-01	1.3E+07	2.7E-05	8.2E-05
38	Sr	2.3E+01	7.0E-01	4.4E+07	8.9E-05	2.8E-04
39	Y	4.6E+00	1.4E-01	8.8E+06	1.8E-05	5.6E-05
40	Zr	1.1E+01	3.4E-01	2.2E+07	4.3E-05	1.4E-04
41	Nb	7.0E-01	2.1E-02	1.3E+06	2.6E-02	8.7E-06
42	Mo	2.5E+00	7.6E-02	4.8E+06	9.7E-06	3.3E-05
44	Ru	1.9E+00	5.6E-02	3.5E+06	7.0E-06	2.5E-05
45	Rh	3.4E-01	1.0E-02	6.5E+05	1.3E-06	4.8E-06
46	Pd	1.4E+00	4.2E-02	2.6E+06	5.3E-06	2.0E-05
47	Ag	4.9E-01	1.5E-02	9.2E+05	1.8E-06	7.1E-06
48	Cd	1.6E+00	4.8E-02	3.0E+06	6.1E-06	2.4E-05

49	In	1.8E-01	5.5E-03	3.5E+05	7.0E-07	2.9E-06
50	Sn	3.8E+00	1.1E-01	7.2E+06	1.4E-05	6.1E-05
51	Sb	3.1E-01	9.3E-03	5.8E+05	1.2E-06	5.1E-06
52	Te	4.8E+00	1.4E-01	9.1E+06	1.8E-05	8.3E-05
53	I	9.0E-01	1.8E-02	1.1E+06	2.3E-06	1.0E-05
54	Xe	4.7E+00	4.7E-02	3.0E+06	6.0E-06	2.8E-05
55	Cs	3.7E-01	1.1E-02	6.9E+05	1.4E-06	6.7E-06
56	Ba	4.5E+00	1.3E-01	8.5E+06	1.7E-05	8.3E-05
57	La	4.5E-01	1.3E-02	8.4E+05	1.7E-06	8.3E-06
58	Ce	1.1E+00	3.4E-02	2.2E+06	4.3E-06	2.1E-05
59	Pr	1.7E-01	5.0E-03	3.2E+05	6.3E-07	3.2E-06
60	Nd	8.3E-01	2.5E-02	1.6E+06	3.1E-06	1.6E-05
62	Sm	2.6E-01	7.7E-03	4.9E+05	9.8E-07	5.2E-06
63	Eu	9.7E-02	2.9E-03	1.8E+05	3.7E-07	2.0E-06
64	Gd	3.3E-01	9.9E-03	6.2E+05	1.2E-06	7.0E-06
65	Tb	6.0E-02	1.8E-03	1.1E+05	2.3E-07	1.3E-06
66	Dy	3.9E-01	1.2E-02	7.5E+05	1.5E-06	8.6E-06
67	Ho	8.9E-02	2.7E-03	1.7E+05	3.4E-07	2.0E-06
68	Er	2.5E-01	7.5E-03	4.7E+05	9.5E-07	5.6E-06
69	Tm	3.8E-02	1.1E-03	7.2E+04	1.4E-07	8.6E-07
70	Yb	2.5E-01	7.4E-03	4.7E+05	9.4E-07	5.8E-06
71	Lu	3.7E-02	1.1E-03	6.9E+04	1.4E-07	8.7E-07
72	Hf	1.5E-01	4.6E-03	2.9E+05	5.8E-07	4.2E-06
74	W	1.3E-01	4.0E-03	2.5E+05	5.0E-07	3.3E-06
75	Re	5.2E-02	1.6E-03	9.8E+04	2.0E-07	1.3E-06
76	Os	6.8E-01	2.0E-02	1.3E+06	2.6E-06	1.7E-05
77	Ir	6.6E-01	2.0E-02	1.3E+06	2.5E-06	1.7E-05
78	Pt	1.3E+00	4.0E-02	2.5E+06	5.1E-06	3.5E-05
79	Au	1.9E-01	5.6E-03	3.5E+05	7.1E-07	5.0E-06
80	Hg	3.4E-01	6.7E-03	4.3E+05	8.7E-07	6.1E-06
81	Tl	1.8E-01	5.5E-03	3.5E+05	6.9E-07	5.1E-06
82	Pb	3.2E+00	9.4E-02	6.0E+06	1.2E-05	8.8E-05
83	Bi	1.4E-01	4.3E-03	2.7E+05	5.5E-07	4.0E-06
90	Th	3.4E-02	1.0E-03	6.3E+04	1.3E-07	1.1E-06
92	U	9.0E-03	2.7E-04	1.7E+04	3.4E-08	2.9E-07

Note 1: Entries in this table refer to unconcentrated bulk solar wind.

Note 2: Solar system abundance relative to Si=10⁶

Note 3: Solar wind concentration averaged over the outer 100 nm of the collector (assumed to be Si) in units of parts per million by number; i.e., (number of solar wind atoms x10⁶)/(atoms of silicon).

Note 4: Solar wind concentration averaged over the outer 100 nm in units of parts per million by weight; i.e. (grams of solar wind element X10⁶)/(grams of silicon).

Appendix B
**GENESIS SOLAR WIND SAMPLE
LOAN AGREEMENT
For Sample Investigators**

The Johnson Space Center (JSC) of the National Aeronautics and Space Administration (NASA), a Federal Agency, desires to enter into a Loan Agreement and to make certain material available to «institution», hereinafter referred to as the INSTITUTION. The Sample Investigator proposes to use said material to undertake scientific investigations proposed to the Genesis Allocation Subcommittee of the Curation, Analysis and Planning Team for Extraterrestrial Materials (CAPTEM). The Sample Investigator is the agent and must provide a copy of this agreement to his or her institution.

The use of the material by the Sample Investigator will permit beneficial contact between representatives of JSC and the INSTITUTION to provide opportunities for discovery and dissemination of information concerning the Genesis collector samples, promote maximum utilization of material by JSC and provide opportunities for dissemination of information concerning the activities of the National Aeronautics and Space Administration.

It therefore is agreed as follows:

1. The samples (hereinafter referred to as the PROPERTY) made subject to this agreement will be assigned to the Sample Investigator on Genesis Solar Wind Sample Assignment Forms signed by the JSC Genesis Curator and the Sample Investigator of [INSTITUTION NAME].
2. The PROPERTY is the property of the United States Government, is considered irreplaceable, and is therefore made available to users only under a carefully controlled and monitored program. It is therefore essential that rigorous security and accountability procedures be followed by all persons who have access to the PROPERTY. The Sample Investigator will be responsible for the receipt, use (including security during use), accountability, and return of the PROPERTY at the end of the designated time. The Sample Investigator will agree to strictly adhere to the following procedures for the security of the PROPERTY:
 - a. Only persons authorized by the Sample Investigator may receive and open the package. The Sample Investigator shall record all of the PROPERTY promptly upon receipt, and it shall be so identified so long as it remains in the custody, possession, or control of the Sample Investigator.
 - b. Verification of sample transfers by electronic media shall be from persons authorized by the Sample Investigator using institutional computer accounts which are secured with password protection and under the exclusive control of the authorized person.
 - c. During use the PROPERTY must be under the control of the Sample Investigator. At the end of each use of the PROPERTY, an inventory shall be made to insure the accountability of the PROPERTY. Such inventories shall be maintained as a permanent record and shall be made accessible to NASA at all reasonable times.
 - d. When not in use, the PROPERTY must be locked in a safe or secure storage cabinet equipped with a combination padlock, or, if controlled environment is required, in a locked laboratory.
 - e. Combination to the storage safe or cabinet will be under the exclusive control of the Sample Investigator and/or his/her designee.
 - f. Report immediately the loss or damage of the PROPERTY to the Genesis Curator, Johnson Space Center, Houston, Texas 77058, telephone (281) 483-5766. Alternate number is Astromaterials Curator Carlton Allen (281) 483-5126.

- g. Transfer of samples among Sample Collaborators is allowed only after the Sample Collaborator has submitted a signed Genesis Solar Wind Sample User Agreement to the Genesis Curator. The accountability for the sample remains the responsibility of the Sample Investigator to whom the sample is assigned. The Genesis Curator must be notified of samples transferred to Sample Collaborators.
 - h. The PROPERTY shall be either hand-carried by the Sample Investigator's authorized official or mailed via FedEx or equivalent responsible, real-time tracking courier. The JSC reserves the right at the INSTITUTION's expense, to direct the mode of transportation for the PROPERTY. Shipping of samples among Sample Collaborators shall be carefully tracked and consists of 3 steps: 1) verify recipient is available to receive package on arrival date, 2) upon arrival, recipient immediately acknowledges receipt, and 3) sender inquires about package receipt if recipient does not respond on the day of expected arrival.
3. NOTWITHSTANDING any other provision of this agreement, the INSTITUTION shall not be liable for loss of or damage to the PROPERTY, or for the expenses incidental to such loss or damage, except that the INSTITUTION shall be responsible for any such loss or damage (including expenses incidental thereto):
 - a. which results from willful misconduct or lack of good faith on the part of the Sample Investigator, or
 - b. which results from a failure on the part of the INSTITUTION due to the willful misconduct or lack of good faith on the part of any of its representatives to maintain and administer, in accordance with the provisions of this agreement, the program for delivery, protection, and preservation of Government property, or to take all reasonable steps to comply with any written directions from JSC with respect to the delivery, protection, and preservation of Government property.

Loss or damage to the PROPERTY caused by failure to follow proper safeguarding standards as set forth in this agreement will be considered in selecting participants in future agreements.
 4. Title to the PROPERTY shall remain with NASA and shall not be affected by the incorporation, attachment, or mixture thereof to or with property not owned by NASA.
 5. This agreement shall become effective upon the date of the last signature hereto and will remain in effect for four years.
-

INSTRUCTION NOTE: Please fill in name of your institution where highlighted in yellow.

As a clarification, the following definitions from Section 5 of the Genesis Research Sample Investigator's Guidebook are reprinted:

Sample Investigator – the person to whom responsibility for security and accountability for the Genesis solar wind sample is assigned. Usually this is the person who submitted the request for samples. This person signs the **Loan Agreement** and signs the Genesis Sample Assignment form when samples are received.

Sample Collaborator – a person working with the Sample Investigator who may have temporary custody of the sample for analytical purposes. This person signs the **User Agreement**.

FOR: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Judith Allton
Genesis Curator
Johnson Space Center

Date

FOR: **«institution»** (full name of the institution)

Signature

Date

Printed Full Name

Title

E-mail: _____

Telephone: _____

Appendix B
**GENESIS SOLAR WIND SAMPLE
USER AGREEMENT**

I, _____ (sample recipient's name, printed) am collaborating with Genesis Sample Investigator _____ (Investigator's name, printed). I have read the sample security protocols below and agree to abide by them.

1. The samples (hereinafter referred to as the PROPERTY) made subject to this agreement are assigned to _____ (Sample Investigator's name, printed).
2. The PROPERTY is the property of the United States Government, is considered irreplaceable, and is therefore made available to users only under a carefully controlled and monitored program. It is therefore essential that rigorous security and accountability procedures be followed by all persons who have access to the PROPERTY. The Sample Investigator will be responsible for the receipt, use (including security during use), accountability, and return of the PROPERTY at the end of the designated time.
 - a. Only persons authorized by the Sample Investigator may receive and open the package. The authorized recipient shall record all of the PROPERTY promptly upon receipt, and it shall be so identified so long as it remains in the custody, possession, or control of the recipient.
 - b. Verification of sample transfers by electronic media shall be from persons authorized by the Sample Collaborator using institutional computer accounts which are secured with password protection and under the exclusive control of the authorized person.
 - c. During use, the PROPERTY must be under the control of the recipient, acting for the accountable Sample Investigator.
 - d. When not in use, the PROPERTY must be locked in a safe or secure storage cabinet equipped with a combination padlock, or, if controlled environment is required, in a locked laboratory.
 - e. Combination to the storage safe or cabinet will be under the exclusive control of the Sample Collaborator and/or his/her designee.
 - f. Report immediately the loss or damage of the PROPERTY to the Genesis Curator, Johnson Space Center, Houston, Texas 77058, telephone (281) 483-5766. Alternate number is Astromaterials Curator Carlton Allen (281) 483-5126.
 - g. Transfer of samples among collaborators is allowed if the collaborator has submitted a signed Genesis Solar Wind Sample User Agreement to the Genesis Curator. The accountability for the sample remains the responsibility of the Sample Investigator to whom the sample is assigned. The Genesis Curator should be notified of samples transferred to collaborators.
 - h. The PROPERTY shall be either hand-carried by the Sample Investigator's authorized persons or mailed via FedEx or equivalent responsible, real-time tracking courier. Shipping of samples among collaborators shall be carefully tracked and consists of 3 steps: 1) verify recipient is available to receive package on arrival date, 2) upon arrival, recipient immediately acknowledges receipt, and 3) sender inquires about package receipt if recipient does not respond on the day of expected arrival.

FOR: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Judith Allton
Genesis Curator
Johnson Space Center

Date

FOR: Collaborator of _____ (Sample Investigator name, printed)

Signature

Date

Printed Full Name

Title

E-mail:

Telephone:

As a clarification, the following definitions from Section 5 of the Genesis Research Sample Investigator's Guidebook are reprinted:

Sample Investigator – the person to whom responsibility for security and accountability for the Genesis solar wind sample is assigned. Usually this is the person who submitted the request for samples. This person signs the **Loan Agreement** and signs the Genesis Sample Assignment form when samples are received.

Sample Collaborator – a person working with the Sample Investigator who may have temporary custody of the sample for analytical purposes. This person signs the **User Agreement**.

Appendix C

JSC Genesis Solar Wind Sample
SAMPLE ASSIGNMENT FORM

Date:
CO:

JSC Tracking Number:	Genesis-Flown Sample Description
Transfer from: NASA - Johnson Space Center Genesis Curator <hr/> Judith H. Allton Date:	Processor:
Transfer to:	
SAMPLE RETURN DATE: (usually one year from date of issue) Notes & Special Handling Instructions:	

JSC Genesis Form #100

October 3, 2005

I acknowledge receipt of, and responsibility for, the above sample(s):

 Signature & Date

 Recipient's name, printed

 Title

**UPON RECEIPT OF THE SAMPLE(S), PLEASE SIGN THIS FORM AND RETURN IT TO THE
 GENESIS SOLAR WIND SAMPLE CURATOR, MAIL CODE KT, JOHNSON SPACE CENTER,
 HOUSTON, TX 77058.**

Appendix D
Example
GENESIS SOLAR WIND SAMPLE RETURN RECEIPT

The Curator acknowledges receipt of materials identified by the following sample numbers:

FROM: [Investigator Name]

ON: [Date]

60019
53201
21169

These samples are being processed back into the active collection and will be cleared from your inventory.

Genesis Solar Wind Sample Curator

**Appendix E
Example****GENESIS-FLOWN SAMPLE INVENTORY
For “Smith, J”**

DATE: October 10, 2005

Sample	Return Date
30221	October 2006
33377	October 2006
55288	October 2006

I acknowledge that I have control of the above sample(s).

Signature Date
Name printed:

I witnessed and verify the above inventory.

Signature Date
Name printed: